

## VT AGENCY OF TRANSPORTATION

## PROGRAM DEVELOPMENT DIVISION

## HYDRAULICS UNIT

TO: Tom Anderson, District 6 Project Manager

FROM: David Willey, Hydraulics Project Supervisor *Deu*

DATE: May 7, 2010

SUBJECT: Calais T.H. 6 (Center Road) - Site in Adamant, 100' south of the intersection



We have completed our preliminary hydraulic study for the above referenced site, and offer the following information for your use:

**Hydrology**

This site has a hilly drainage basin. It is a mixture of forested and open land cover, with several large ponds and wetland areas. The total contributing drainage area is about 2.4 sq. mi. There is an overall length of 15,800 feet from the divide to the site, with a 610-foot drop in elevation, giving an average overall channel slope of 3.8 %. The stream slope at the site was estimated to be about 3%. Using several hydrologic methods, we came up with the following design flow rates:

<u>Recurrence Interval in Years</u>	<u>Flow Rate in Cubic Feet per Second (CFS)</u>
Q2.33	95
Q10	205
Q25	275 - Town Highway Design Flow
Q50	345
Q100	410 - Check flow

**Existing Conditions**

The existing structure is 5.0' diameter corrugated metal pipe, providing a waterway opening of 19.6 sq. ft. The stream is not aligned well at the inlet, as it makes several sharp turns coming into the pipe. The channel is straight going out of the pipe. There is a concrete retaining wall along one side of the downstream channel, with a house set back several feet from that wall.

Water recently overtopped the roadway at this site, when an upstream beaver dam failed and caused flooding in this area.

Our calculations show the existing structure is not adequate hydraulically. Water may overtop the roadway below the design Q25, and headwater to depth ratios exceed the allowable values.

**Recommendations**

In sizing a new structure we attempted to select structures that met the hydraulic standards, fit the natural channel width, the roadway grade and other site conditions. Due to the low height from the stream bed to the roadway, a box is the only type of structure that will fit the site. We recommend any of the following structures as a replacement at this site:

1. A concrete box with a 10' wide by 5' high inside opening, providing 50-sq. ft. of waterway area, could be considered. This size box would have minimal cover as there is about 6.0' from the stream bed to the roadway. This structure will result in a headwater depth at  $Q_{25} = 4.8'$  and at  $Q_{100} = 6.6'$ , with no roadway overtopping at  $Q_{50}$ .
2. If more cover is desired, a box with a 12' wide by 4' high inside opening, providing 48-sq. ft. of waterway area, could be used. This structure will result in a headwater depth at  $Q_{25} = 4.3'$  and at  $Q_{100} = 6.0'$ , with no roadway overtopping at  $Q_{100}$ .
3. Any similar structure with a minimum clear span of 10' and at least 48-sq. ft. of waterway area, that fits the site conditions, could be considered.

#### **General comments**

If a new box is installed, we recommend it have full headwalls at the inlet and outlet. The headwalls should extend at least four feet below the channel bottom, or to ledge, to act as cutoff walls and prevent undermining.

It is always desirable for a new structure of this size to have flared wingwalls at the inlet and outlet, to smoothly transition flow through the structure, and to protect the structure and roadway approaches from erosion. The wingwalls should match into the channel banks. Any new structure should be properly aligned with the channel, and constructed on a grade that matches the channel. The new box will need to be properly aligned to match into the downstream retaining wall. It would be desirable to improve the channel alignment upstream of the structure, to eliminate the sharp turns at the inlet.

Stone Fill, Type II should be used to protect any disturbed channel banks or roadway slopes at the structure's inlet and outlet, up to a height of at least one-foot above the top of the opening. The stone fill should not constrict the channel or structure opening.

The Agency of Natural Resources (ANR), Corps of Engineers, or other permitting agency may have additional concerns regarding replacement of this structure, or any channel work. The Stream Alteration Engineer should be contacted with respect to those concerns, before a replacement structure is ordered. If ANR requires the invert of the box to be buried to provide a natural bottom, the size of the structure will have to be larger to provide the required waterway area.

Please keep in mind that while a site visit was made, these recommendations were made without the benefit of a survey and are based on limited information. The final decision regarding the replacement of this structure should take into consideration matching the natural channel conditions, the roadway grade, environmental concerns, safety, and other requirements of the site.

Please contact us if you have any questions or if we may be of further assistance.

DCW

cc: Patrick Ross, A.N.R. Stream Alteration Engineer  
Mike Hedges, Structures Engineer  
Hydraulics Project File via NJW  
Hydraulics Chrono File